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The Stokes experiment in a foam - a summary

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One way in which the complex elastic, plastic and viscous properties of a liquid foam can be explored is through the interaction between the foam and an object moving relative to it. This variation on the classic "Stokes" experiment is an important tool to investigate foam rheology. Here, we provide a summary of published experimental or simulation results and categorize them in various ways to highlight common themes and results, and unexplored areas of parameter space.

AUTHOR	TITLE	PUBLISHED	YEAR	Dimensions, Experiment (E) or Simulation (S)	Constant Force / Constant Velocity (CF/CV)	Object in foam	Control Parameters	Data obtained
S.J. Cox, M.D. Alonso, S.Hutzler & D. Weaire	The Stokes Experiment in a Foam	Foams, Emulsions and their applications	2000	**3D** **E**	CF	Sphere	sphere size and flow rate	**sphere velocity, position of the sphere**
A. Wyn, I.T. Davies, S.J. Cox	Simulation of 2D foam Rheology: Localization in linear Couette flow and the interaction of settling discs		2008	**2D** **S**	CF	Two circular discs	Size of obstacles, initial separation between discs, initial orientation of discs	**Centre-points position, rotation and separation variations between discs**
I. Cantat, O. Pitois	Stokes experiment in a liquid foam	Phys. Fluids 18	2006	**3D** **E**	CV	Sphere	Bubble size, fluid fraction,	**Force fluctuations, shear modulus, plastic threshold**
J. R. de Bruyn	Transient and steady–state drag in foam	Rheol. Acta 44, 150-159	2004	**3D** **E**	CV	Sphere	size of container, velocity of sphere	**steady-state drag force, transient and relaxation of force**
J. R. de Bruyn	Age dependence of the drag force in an aqueous foam	Rheol.Acta. 45, 801-811	2005	**3D** **E**	CV	sphere	Size of container, velocity of sphere, age of foam	**drag force, transient and relaxation of force, yield stress,**
I. Cantat, O. Pitois	Mechanical probing of liquid foam ageing	J. Phys. : Condens. Matter 17, S3455-S3461	2005	**3D** **E**	CV	Sphere	bubble size, initial liquid fraction, translation of container, sphere size	**liquid drainage and coarsening measure**

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M. Asipauskas, M. Aubouy, J.A. Glazier, F. Graner, Y. Jiang	A texture tensor to quantify deformations: the example of two-dimensional flowing foams	Granular Matter 5, 67-74	2003	**2D** **E**	CV	Circular disc	liquid fraction, flow rate	**Stress, texture tensor, velocity field, statisticlal strain**
B. Dollet, M. Aubouy, F. Graner	Anti-Inertial Lift in Foams: A Signature of the Elasticity of Complex Fluids	Phys. Rev. Lett. 95	2005	**2D** **E**	CV	Cambered airfoil	flow rate	**torque, lift & drag, velocity, pressure fields,**
B. Dollet, F. Elias, C. Quilliet, A. Huillier, M. Aubouy, F. Graner	Two-dimensional flows of foam: Drag exerted on circular obstacles and dissipation	Colloids and Surfaces 263, 101-110	2005	**2D** **E**	CV	Circular disc	Flow rate, bubble volume, viscosity of solution, size of obstacle, BCs	**Drag force on obstacle, dissipation (pressure gradient)**
B. Dollet, F. Elias, C. Quilliet, C. Raufaste, M. Aubouy, F. Graner	Two-dimensional flow of foam around an obstacle: Force measurements	Phys. Rev. E 71	2005	**2D** **E**	CV	Circular disc	flow rate, bubble volume, size of obstacle, boundary conditions	**yield drag, viscous coefficient,**
B. Dollet, M. Durth, F. Graner	Flow of foam past an elliptical obstacle	Phys. Rev. E 73	2006	**2D** **E**	CV	Ellipse	Initial orientation of obstacle, flow rate	**Drag, lift and torque exerted on the ellipse**
I. Cantat, R. Delannay	Dynamical transition induced by large bubbles in two-dimensional foam flows	Phys. Rev. E 67	2003	**2D** **E**	CV	Large bubble	flow rate /velocity	**pressure fields, velocity threshold & relative velocity**

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B. Dollet, F. Graner	Two-dimensional flow of foam around a circular obstacle: local measurements of elasticity, plasticity and flow	J. Fluid Mech. 585 181-211	2007	**2D** **E**	CV	Circular disc	Obstacle diameter, flow rate, bubble area, foam thickness (liquid fraction), bulk viscosity	**Pressure field, velocity and velocity gradient fields, tensorial fields (texture tensor, statistical elastic strain, T1s)**
P. Marmottant, B. Dollet, C. Raufaste, F. Graner	Local observation of plastic rearrangements in a flowing foam		2006	**2D** **E**	CV	Circular disc	Flow rate, fluid fraction	**Texture tensor, elastic strain tensor, deformation rate tensor, topological tensor**
O. Sun, S. Hutzler	Studying localized bubble rearrangements in 2D liquid foams using a hybrid lattice gas model	Colloids and Surfaces A: Physiochem. Eng. Aspects 263, 27-32	2005	**2D** **E**	CV	Circular disc	Liquid fraction	**spatial variation of bubble rearrangements,**
S. Courty, B.Dollet, F. Elias, P. Heinig, F. Graner	Two-dimensional shear modulus of a Langmuir foam	Europhys. Lett. 64, 709-715	2003	**2D** **E**	CV	Circular (tip of rod)	Motion of the obstacle	**Resistant force on obstacle, stress tensor, statistical stress tensor, shear modulus**
P. Marmottant, C. Raufaste, F. Graner	Discrete rearranging disordered patterns, part II: 2D plasticity, elasticity and flows of a foam		2008	**2D** **E**	CV	Circular disc	Liquid fraction	**Texture tensor, topological tensor, strain tensor, velocity field**

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S.J. Cox, B. Dollet, F. Graner	Foam flow around an obstacle: simulations of obstacle-wall interaction	Rheol. Acta 45,	2006	**2D** **S**	CV	Circular disc	obstacle diameter, bubble area, distance between obstacle and wall	**lift and drag forces, pressure & displacement fields, T1 field**
C. Raufaste, B. Dollet, S.J. Cox, Y. Jiang, F. Graner	Yield drag in a two-dimensional foam flow around a circular obstacle: Effect of liquid fraction	The European Physics Journal E—Soft Matter 23, 217-228	2007	**2D** **E+S**	CV	Circular disc	Liquid fraction, obstacle size, bubble size, channel width	**Network and pressure forces in simulation, total force in experiment, yield drag of foam**

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